Coordinating Cell Activities

Chapter 4.4-4.6

Biol 1A

California State University, Fresno

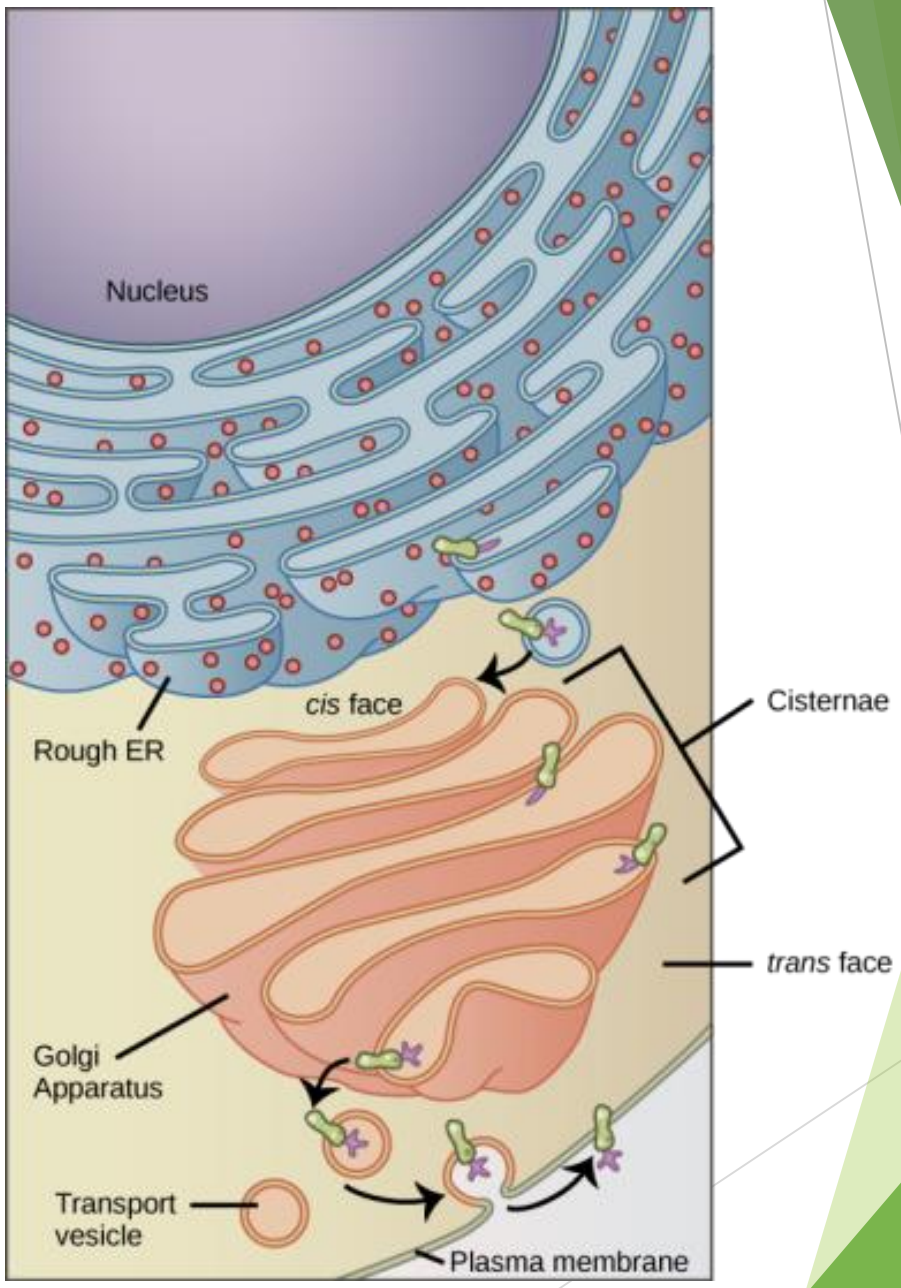
Learning Goals

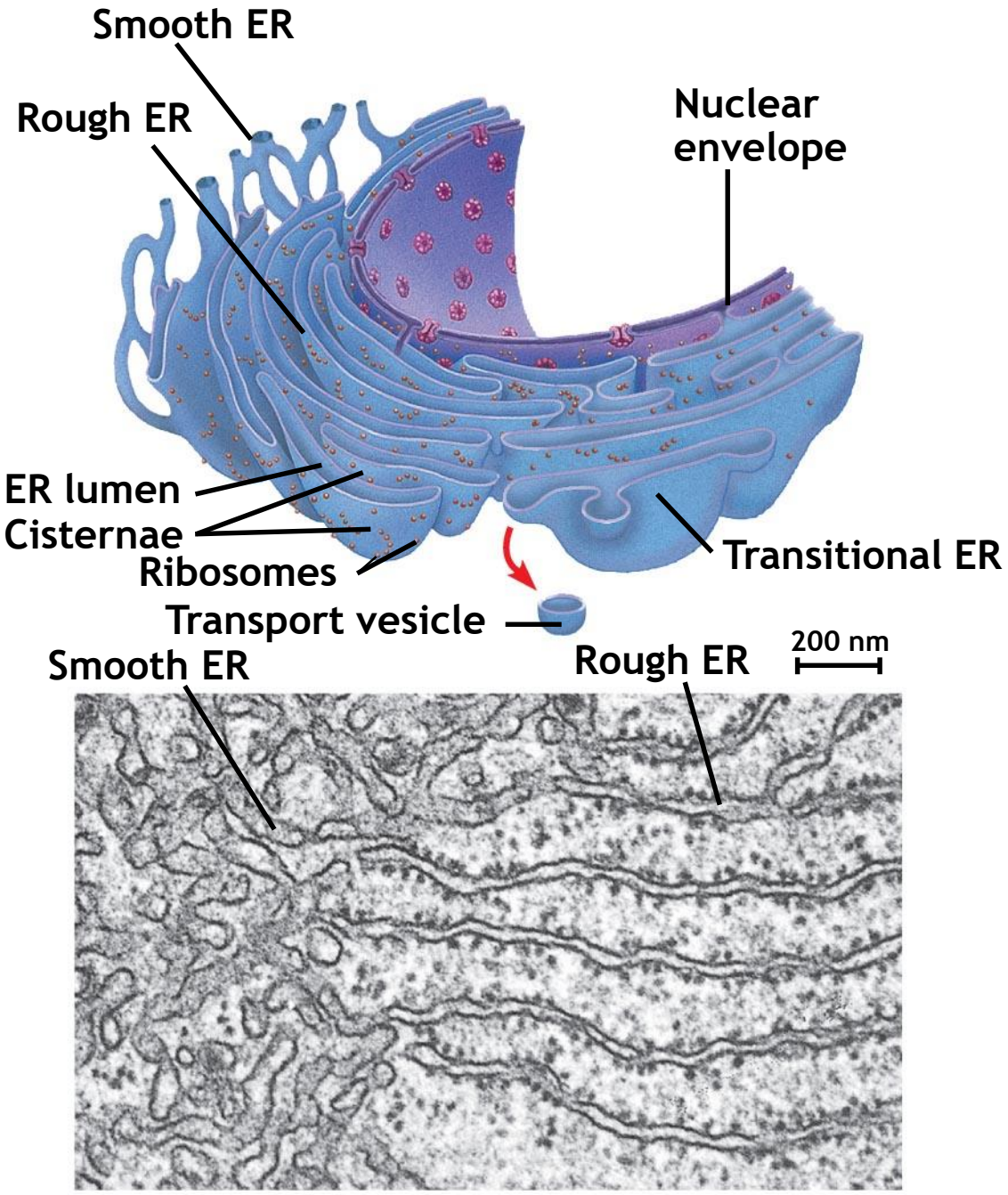
- Describe the endomembrane system and how cells move materials from one component to the next.
- Identify the function of the different parts of the endomembrane system.
- Explain how a secretory protein, such as insulin, is produced in a cell.
- Describe the cytoskeleton and identify its components and their functions.
- Explain how cells in tissues are held together.
- Apply your knowledge of organelles to determine the function of a cell.

The Endomembrane System

- nuclear membrane
- ER
- Golgi apparatus
- Plasma membrane

vesicles move substances among these





endoplasmic reticulum (ER)

- continuous with nuclear envelope
- smooth and rough ER

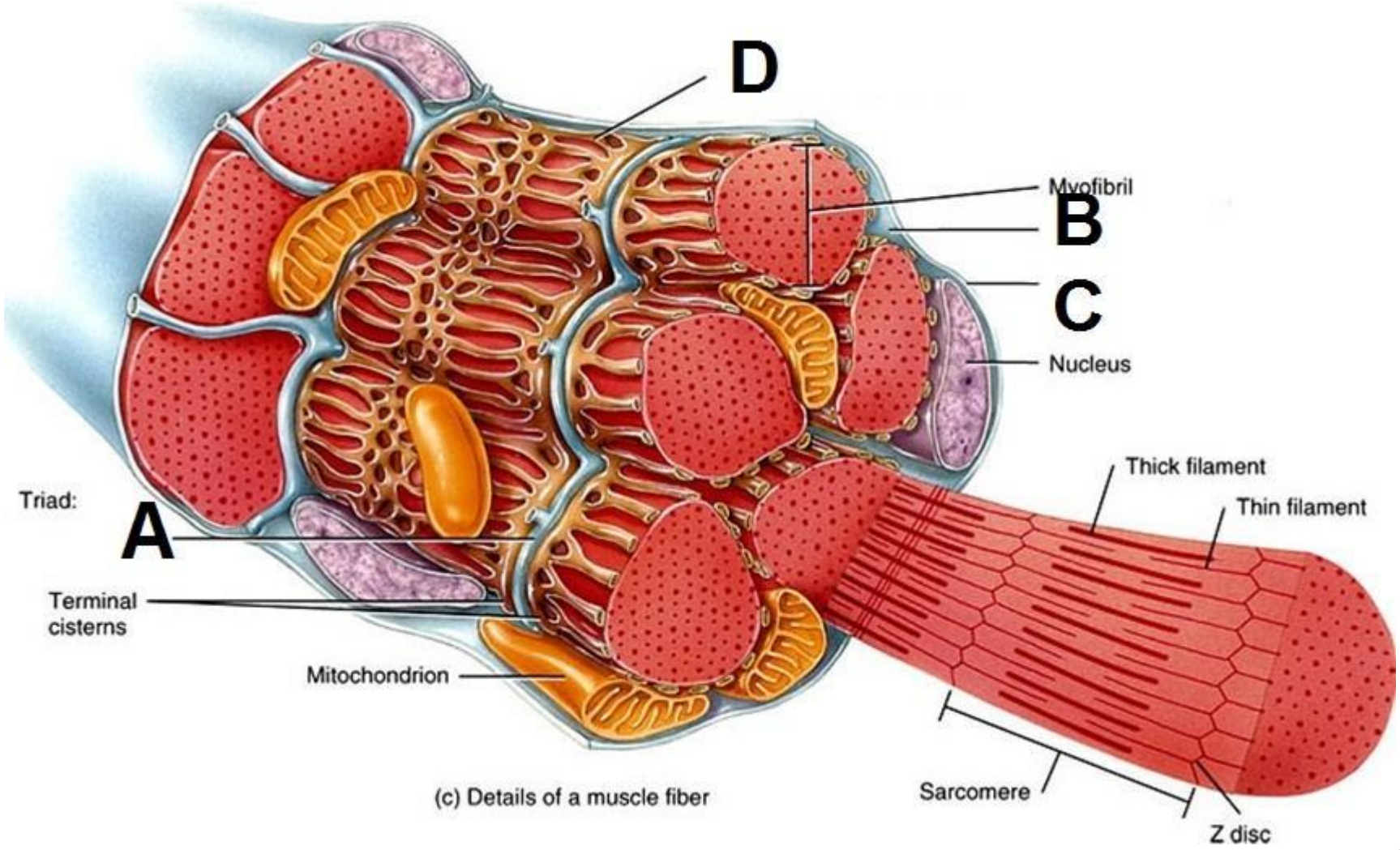
Functions of ER parts

smooth ER

- lipid synthesis
- carbohydrate metabolism
- detoxification
- Ca^{++} ion storage

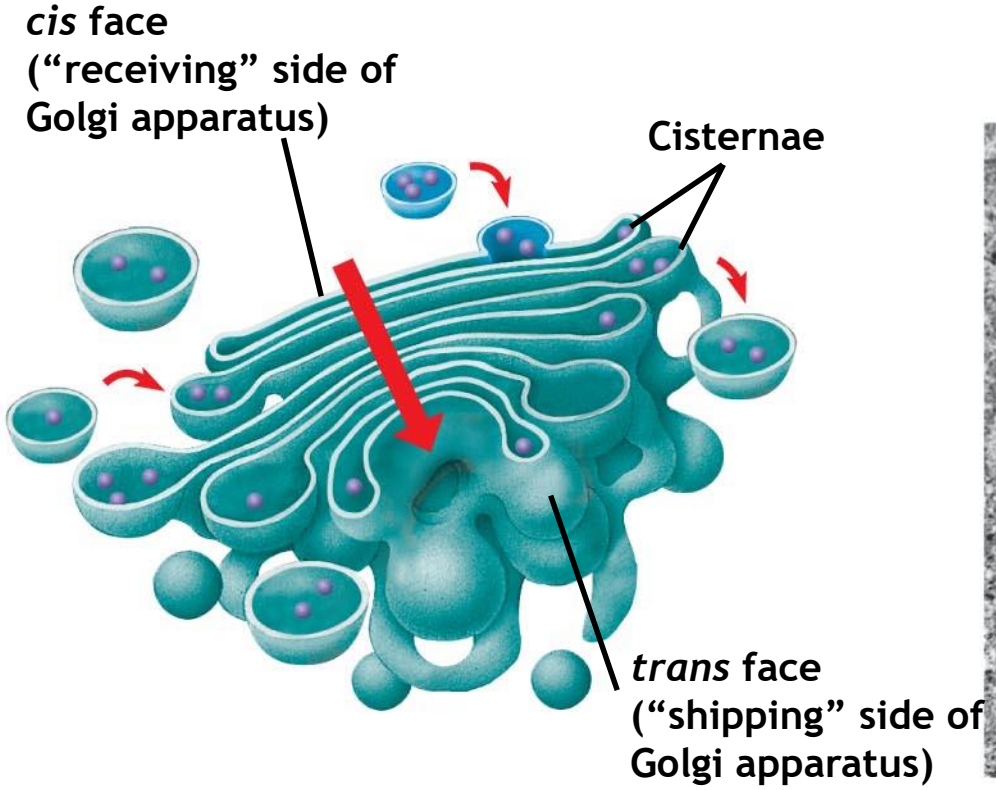
rough ER

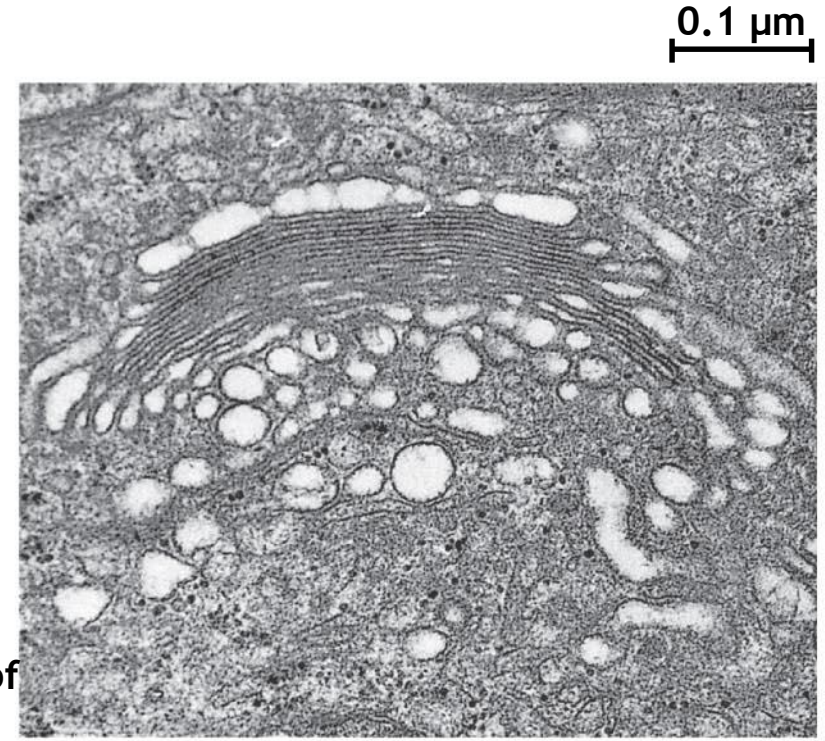
- bound ribosomes: Proteins for secretion, and membrane proteins
- further modification of proteins → glycoproteins
- membranes made here too



(c) Details of a muscle fiber

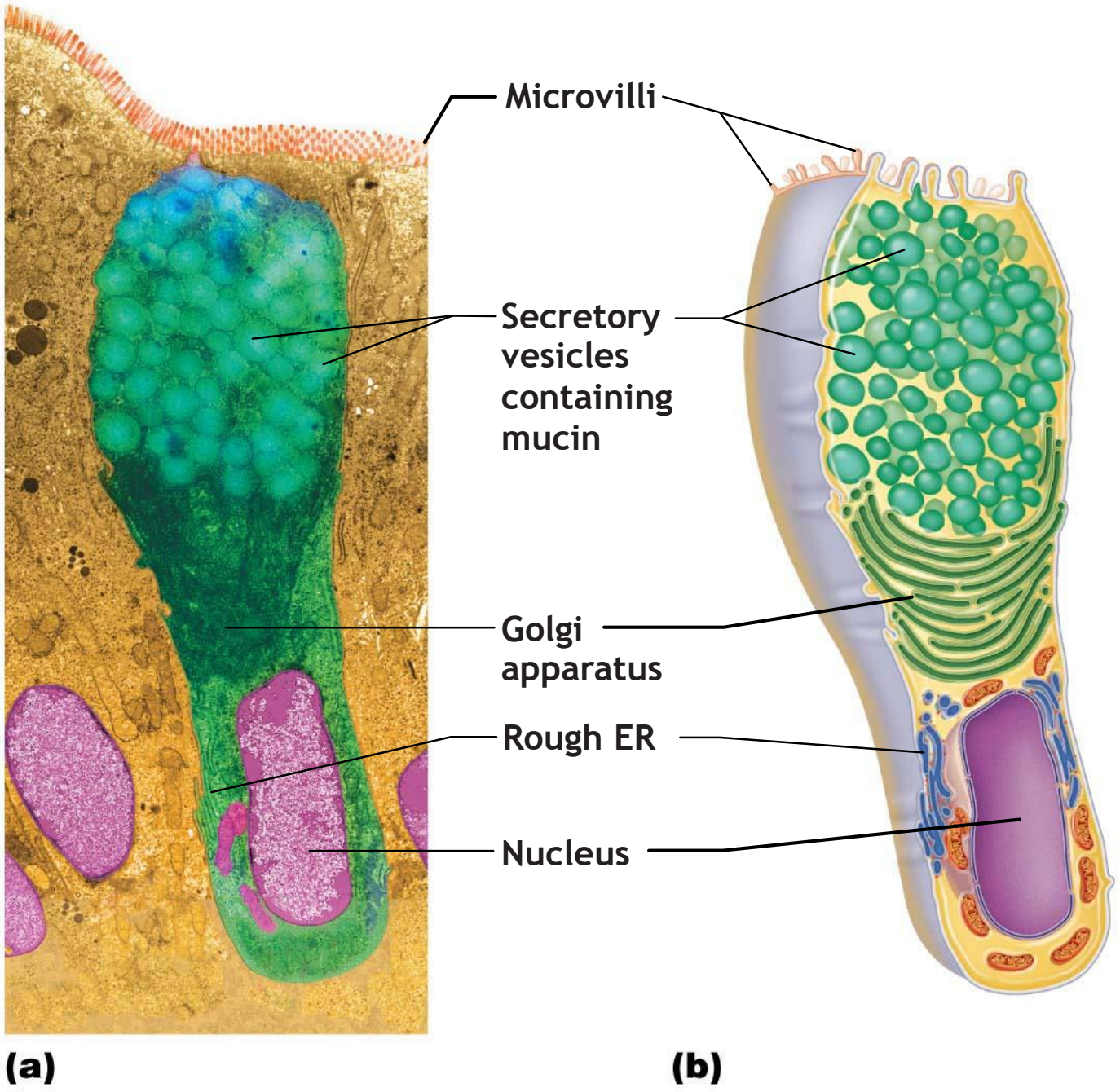
Golgi Apparatus





TEM of Golgi apparatus

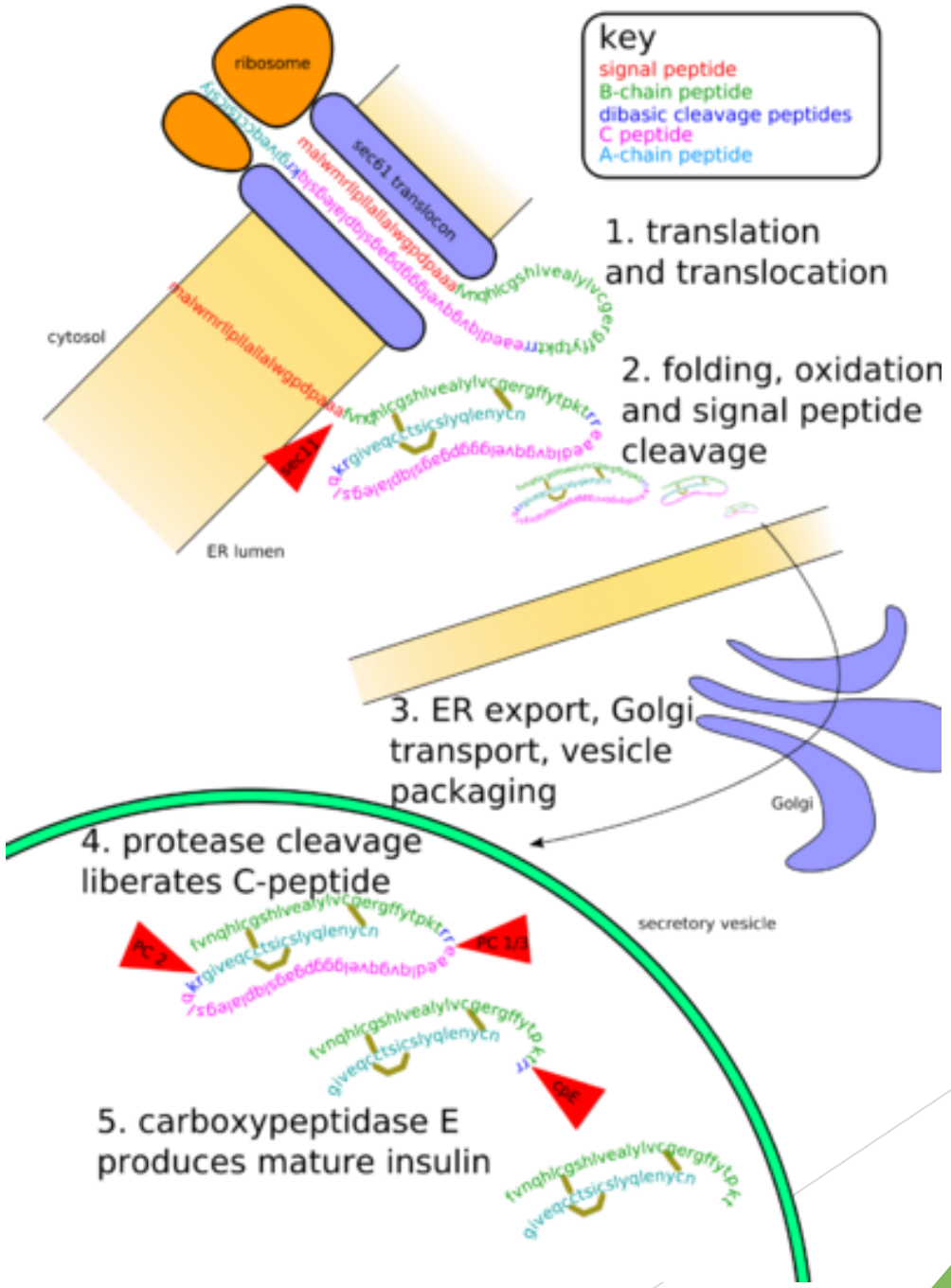
- further modifications to glycoproteins from the ER
- synthesis of some polysaccharides
- packaging center: 'tagging' of products and/or vesicles
- vesicles can go to the plasma membrane after


Microvilli
Secretory vesicles containing mucin
Golgi apparatus
Rough ER
Nucleus
(a)
(b)

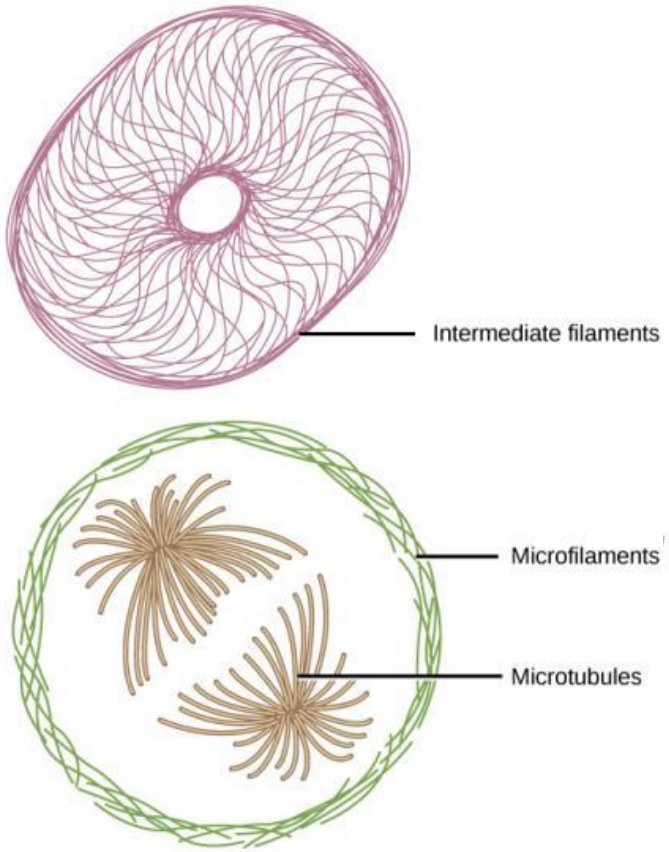
insulin synthesis and secretion

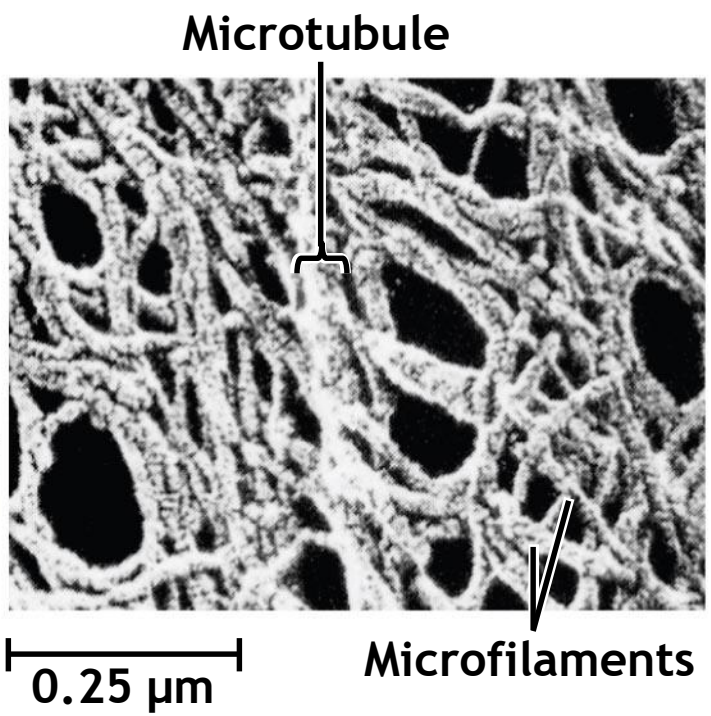
(an example of modification of a secreted protein)

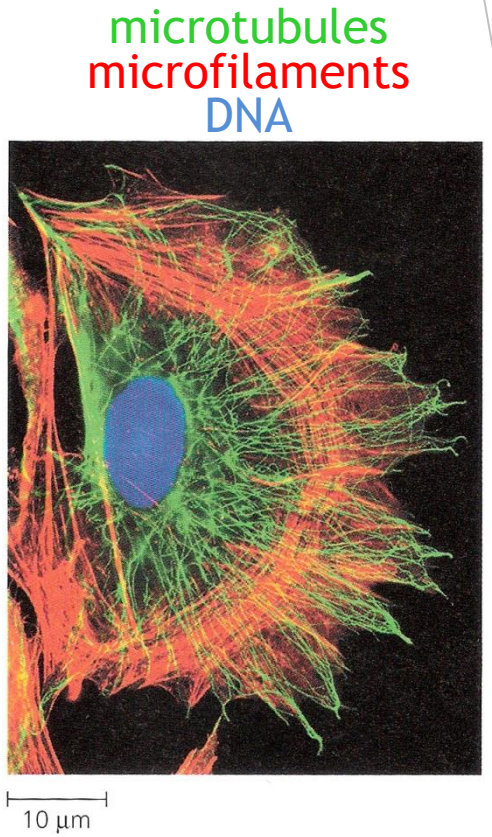
synthesis in ER → transport to Golgi for modification → secretory vesicle → fusion with plasma membrane



The Cytoskeleton

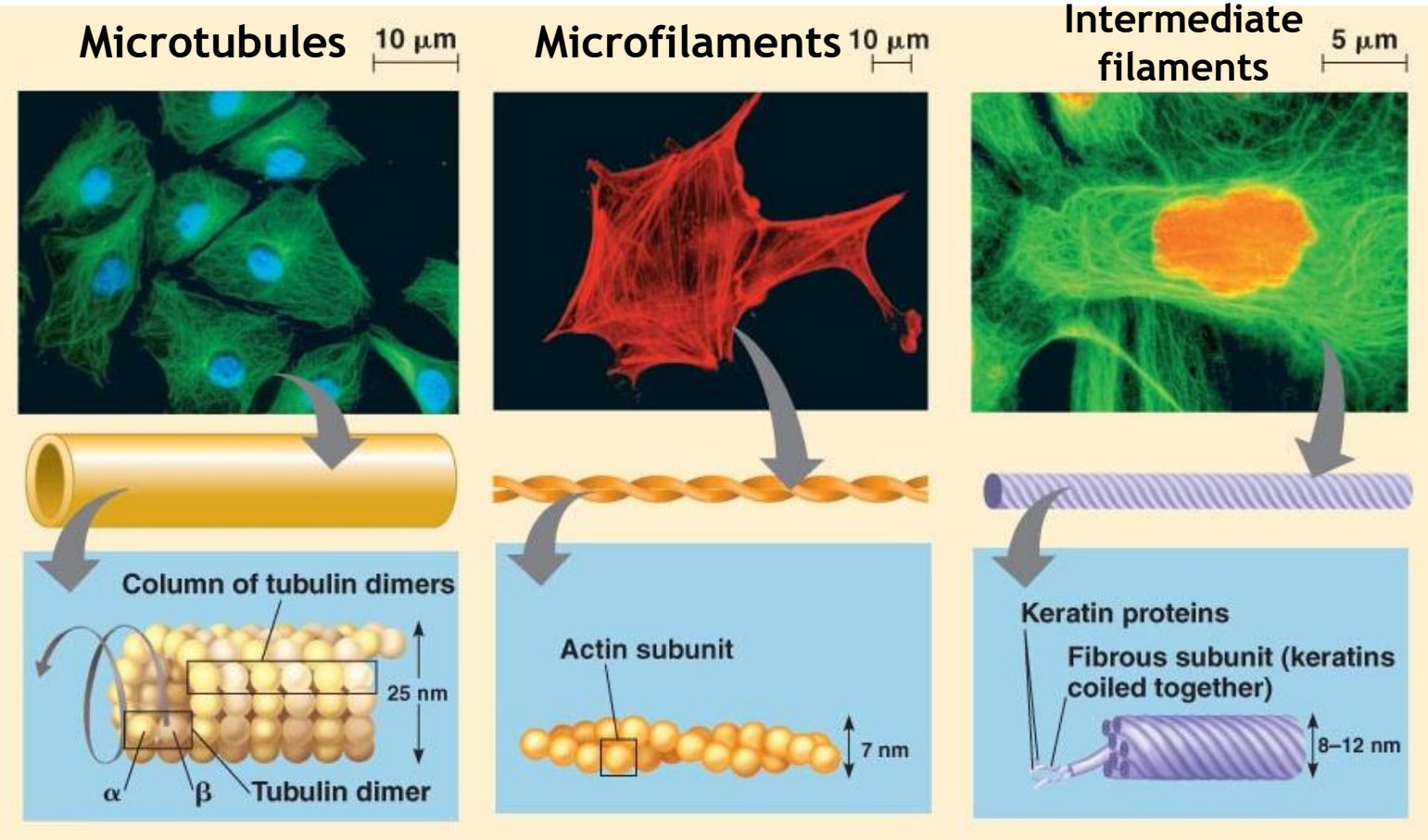






- organelles do not just ‘float’ in cells
  - three types of cytoskeletal fiber

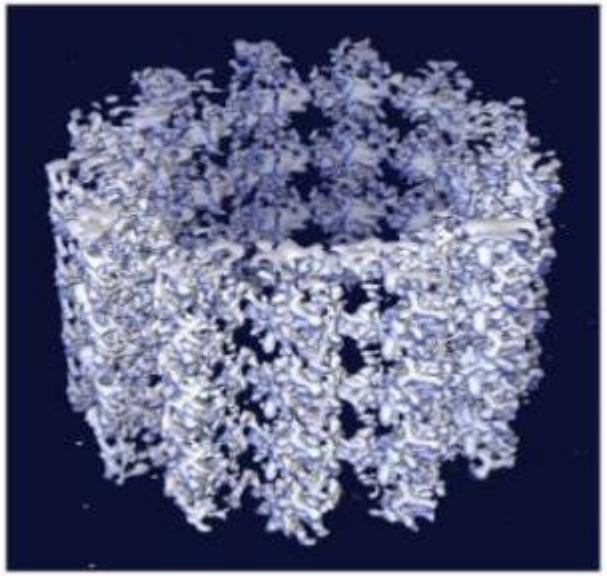
Three types of cytoskeletal fiber

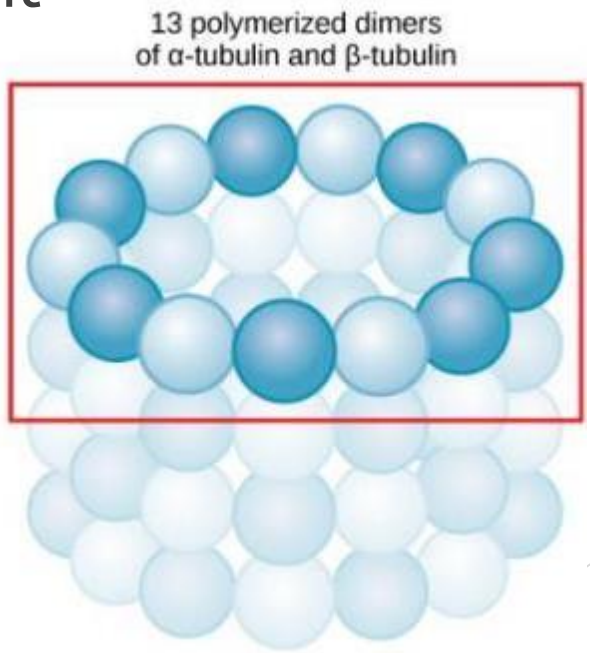


Microtubules

- Hollow rods
- Made of tubulin
- 25nm in diameter

- Maintains cell shape, cell motility, chromosome movement in cell division, organelle movement

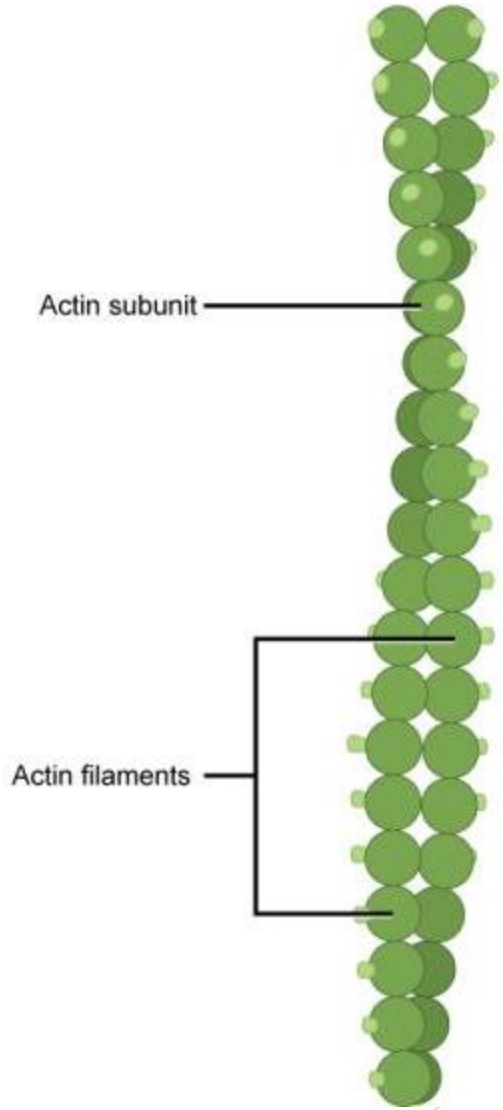




Microfilaments

- Thin solid rods
- Made of two intertwined strands of actin
- 7nm in diameter

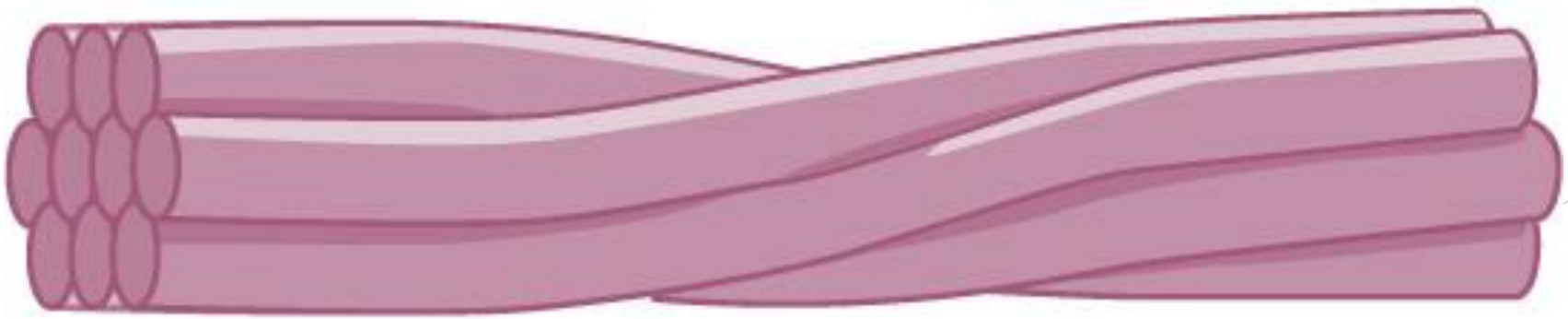
- Maintains cell shape, changes cell shape, muscle contraction, cytoplasmic streaming in plant cells, cell motility, division of animal cells.



Intermediate Filaments

- Fibrous proteins coiled in cables
- 8-12nm
- Made of different proteins (e.g. keratin)

- Maintains cell shape, anchorage of nucleus and certain organelles, formation of nuclear lamina

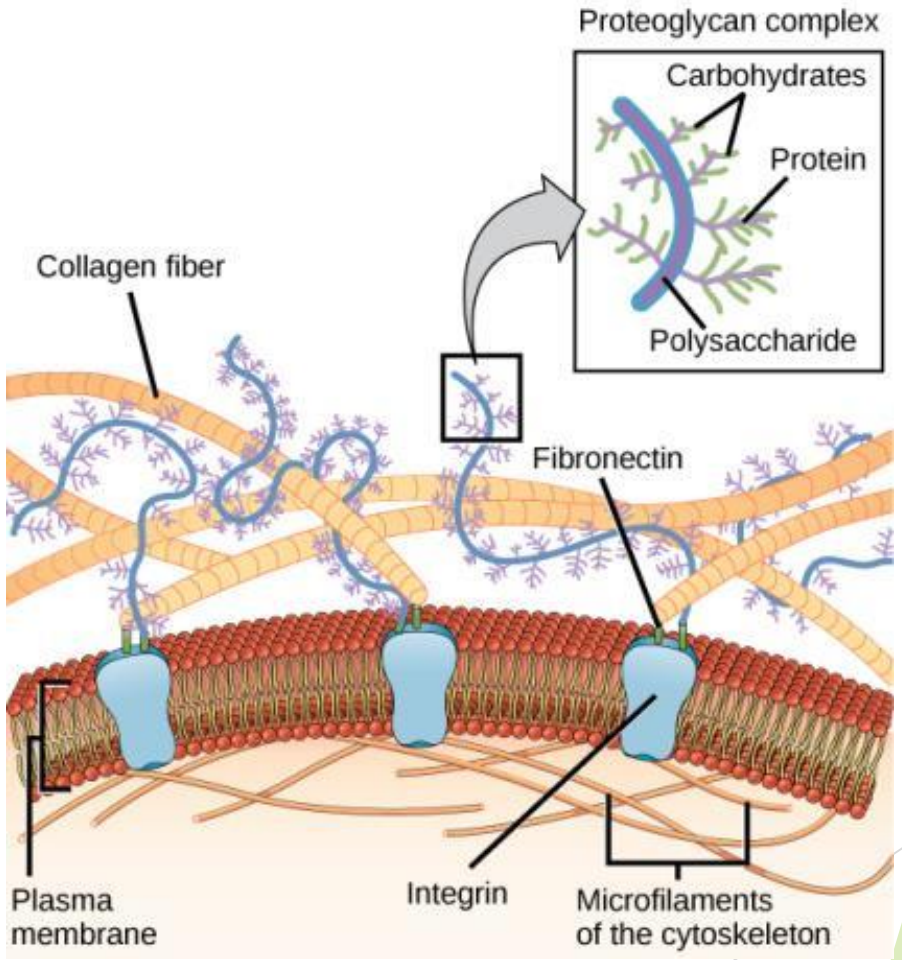


Connections between Cells and Cellular Activities

- You already know that a group of similar cells working together is called a tissue.
- As you might expect, if cells are to work together, they must communicate with each other, just as you need to communicate with others if you work on a group project.
- Let’s take a look at how cells communicate with each other.

Extracellular Matrix of Animal Cells

- Most animal cells release materials into the extracellular space. The primary components of these materials are proteins, and the most abundant protein is **collagen**.
- Not only does the extracellular matrix hold the cells together to form a tissue, but it also allows the cells within the tissue to communicate with each other. How can this happen?



Intercellular Junctions - Plasmodesmata

Plasmodesmata

- Channels that pass between cell walls of adjacent **plant cells**, connect their cytoplasm, and enable materials to be transported from cell to cell, and thus throughout the plant.

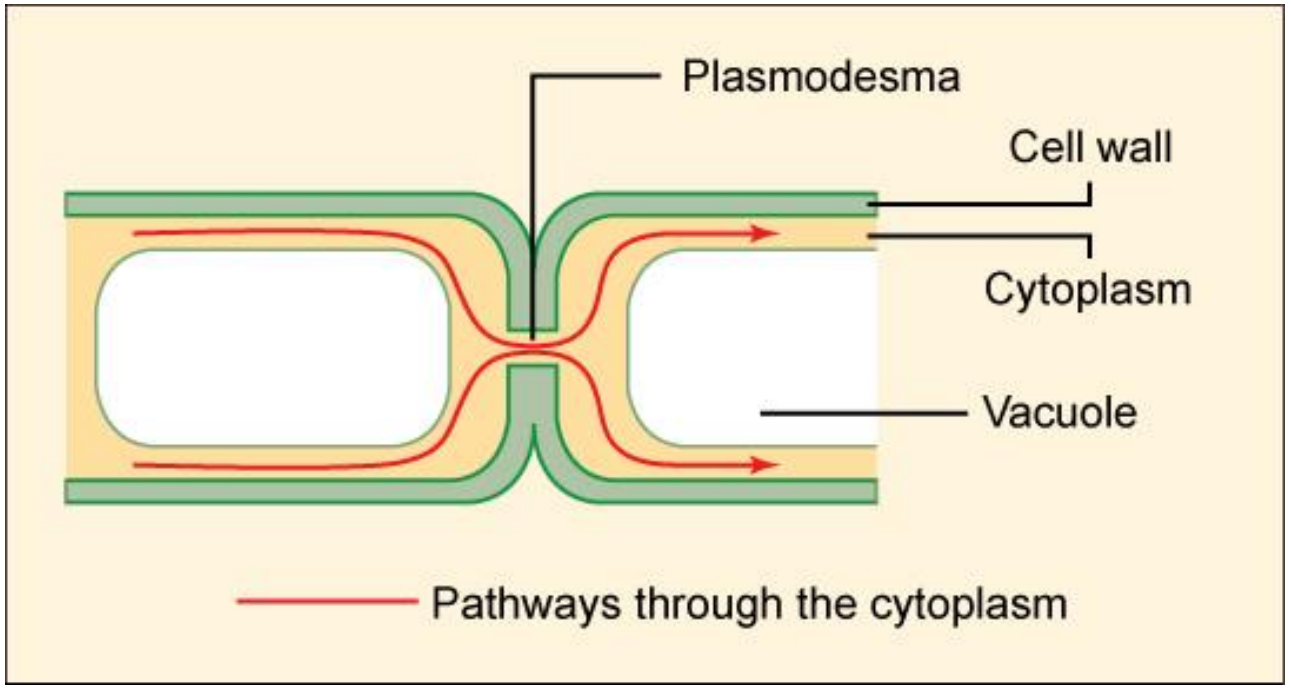
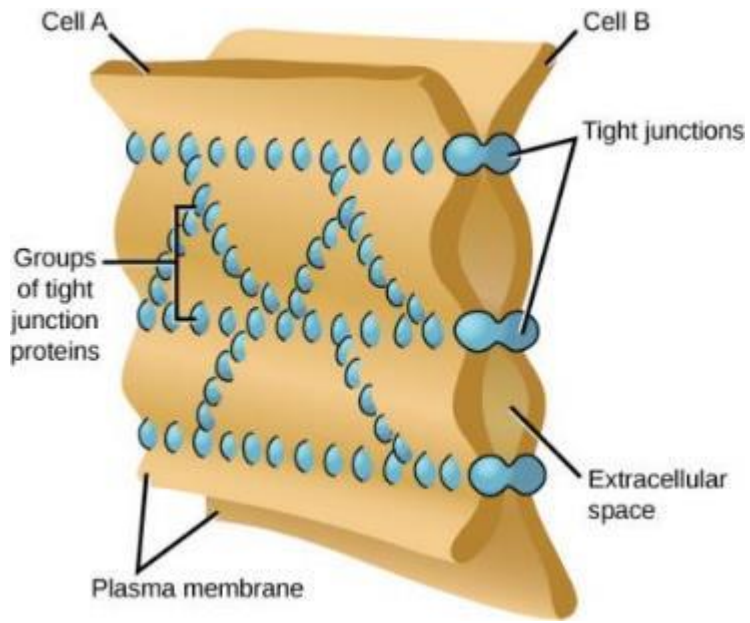


FIGURE 4.28 A plasmodesma is a channel between the cell walls of two adjacent plant cells. Plasmodesmata allow materials to pass from the cytoplasm of one plant cell to the cytoplasm of an adjacent cell.

Intercellular Junctions - Tight Junctions

Tight Junctions

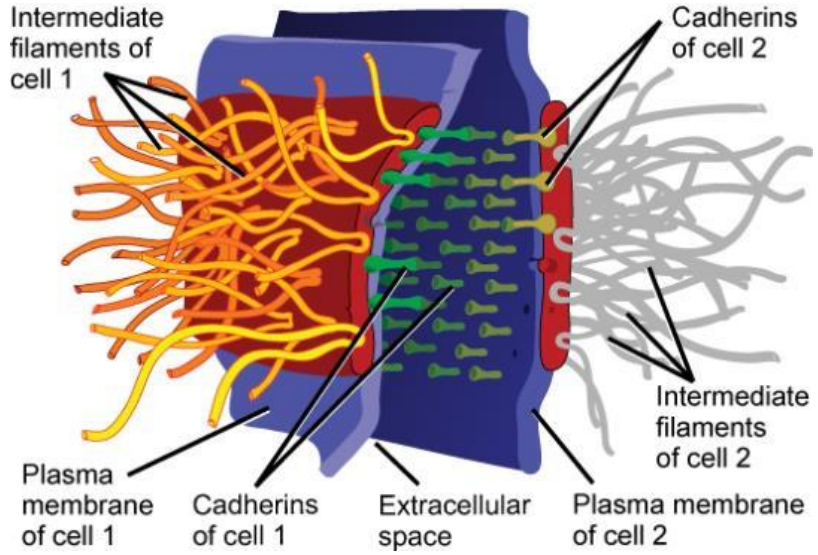
- A tight junction is a watertight seal between two adjacent animal cells. The cells are held tightly against each other by proteins (predominantly two proteins called **claudins** and **occludins**).



Intercellular Junctions - Desmosomes

Desmosomes

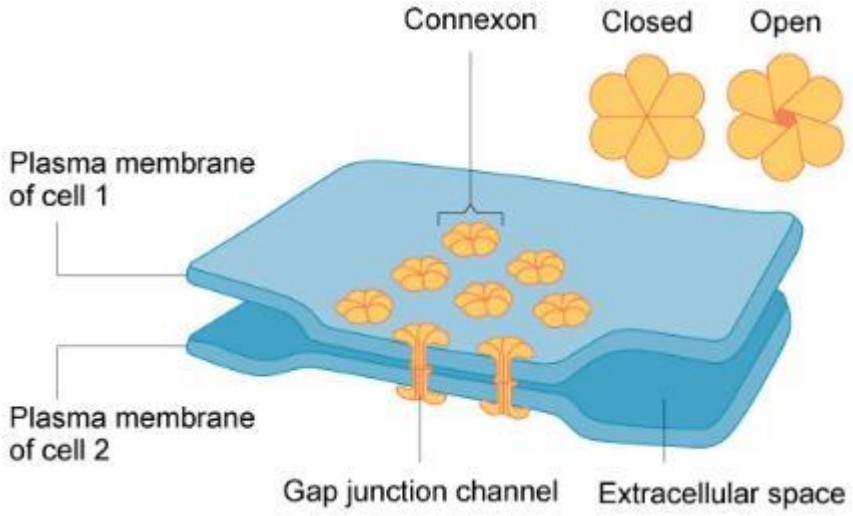
- Also found only in animal cells are desmosomes, which act like spot welds between adjacent epithelial cells.
- Short proteins called **cadherins** in the plasma membrane connect to intermediate filaments to create desmosomes.



Intercellular Junctions – Gap Junctions

Gap Junctions

- Gap junctions in animal cells are like plasmodesmata in plant cells in that they are channels between adjacent cells that allow for the transport of ions, nutrients, and other substances that enable cells to communicate. Structurally, however, gap junctions and plasmodesmata differ.



Take Home

- Membrane sacs called vesicles move between the components of the endomembrane system, making these membranes in a sense, continuous. Know all the parts of the endomembrane system and their functions.
- Membrane proteins and proteins destined for secretion are manufactured in the Rough ER, shipped out to the Golgi and then to the plasma membrane.
- The cytoskeleton is dynamic and always changing. At the same time, it structures the internal environment of the cell. Know the three types of cytoskeletal fibers, where you would find them and what they do.
- Intercellular junctions hold cells together to form tissues with a variety of functions. Describe the four types of junctions discussed and understand how each junction provides a specific function to a tissue.